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**WO 00/75389 A1**

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- (21) International Application Number: PCT/AU00/00630
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PQ 0789 4 June 1999 (04.06.1999) AU
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- (72) Inventor; and
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- (74) Agents: HUNTSMAN, Peter, Harold et al.; Davies Collison Cave, 1 Little Collins Street, Melbourne, VIC 3000 (AU).
- (81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.
- (84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

**Published:**

— With international search report.

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: AIR-SIDE SOLID OXIDE FUEL CELL COMPONENTS

(57) Abstract: A solid oxide fuel cell component, such as a gas separator, which is adapted to be exposed to an oxidising atmosphere in the fuel cell system, and which is formed of a heat resistant alloy having a composition, in wt.%, of 5.0-10.0 Al, 0.1-3.8 Si,  $\leq 0.5$  Mn,  $\leq 0.23$  Cu,  $\leq 0.61$  Ni,  $\leq 0.02$  C,  $\leq 0.04$  P,  $\leq 0.045$ ,  $< 5.0$  Cr, and residue Fe. Preferably Cr  $\leq 0.10$  wt.%. In use the component has a thin, dense, adherent surface layer of Al<sub>2</sub>O<sub>3</sub>.

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## CLAIMS:

1. A solid oxide fuel cell system component which is adapted to be exposed to an oxidising atmosphere in the fuel cell system and which is formed of a heat resistant alloy

5 having a composition, in wt%, of:

Al 5.0 - 10.0

Si 0.1 - 3.8

Mn ≤ 0.5

Cu ≤ 0.23

10 Ni ≤ 0.61

C ≤ 0.02

P ≤ 0.04

S ≤ 0.04

Cr < 5.0

15 Residue Fe, excluding incidental impurities.

2. A solid oxide fuel cell system component according to claim 1 which contains no more than about 8.5 wt% Al.

20 3. A solid oxide fuel cell system component according to claim 1 which contains less than 0.05 wt% Mn.

4. A solid oxide fuel cell system component according to claim 1 wherein the alloy has a composition, in wt%, of:

25 Al  $6.0 \pm 1.0$

Si  $1.0 \pm 0.5$

C 0.005 - 0.02

P ≤ 0.04

S ≤ 0.04

30 Cr ≤ 0.10

(Al + Si) = 6.5 to 7.5

Residue Fe, excluding incidental impurities.

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5. A solid oxide fuel cell system component according to claim 1 wherein the alloy contains no Cr.

6. A solid oxide fuel cell system component according to claim 1 having a surface layer  
5 of  $\text{Al}_2\text{O}_3$ .

7. A solid oxide fuel cell system component according to claim 6 wherein the  $\text{Al}_2\text{O}_3$  surface layer has a thickness in the range of from about 1 to about 10 microns, preferably from about 1 to about 3 microns.

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8. A solid oxide fuel cell system component according to claim 1 wherein source material for the alloy at least includes scrap metal.

9. A solid oxide fuel cell system component according to claim 1 which is a gas separator  
15 disposed or adapted to be disposed between adjacent fuel cells in the system.

10. A solid oxide fuel cell system component according to claim 1 which is a component selected from the group consisting of a manifold, a base plate, a current collector strap, ducting, a heat exchanger and a heat exchanger plate disposed or adapted to be disposed in the solid  
20 oxide fuel cell system.

11. A solid oxide fuel cell system in which one or more components adapted to be exposed to a temperature in excess of  $750^\circ\text{C}$  and an oxidising atmosphere are in accordance with any one of the preceding claims. ✓

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*[Handwritten signature]*

From the INTERNATIONAL BUREAU

**PCT**

**NOTICE INFORMING THE APPLICANT OF THE  
COMMUNICATION OF THE INTERNATIONAL  
APPLICATION TO THE DESIGNATED OFFICES**

(PCT Rule 47.1(c), first sentence)

To:

HUNTSMAN, Peter, Harold  
Davies Collison Cave  
1 Little Collins Street  
Melbourne, VIC 3000  
AUSTRALIE

**WEDNESDAY, 27 DEC 2000**

Date of mailing (day/month/year) 14 December 2000 (14.12.00)		<b>IMPORTANT NOTICE</b>	
Applicant's or agent's file reference 2298733/PHH			
International application No. PCT/AU00/00630	International filing date (day/month/year) 02 June 2000 (02.06.00)	Priority date (day/month/year) 04 June 1999 (04.06.99)	
Applicant CERAMIC FUEL CELLS LIMITED et al			

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:  
**AG,AU,DZ,KP,KR,MZ,US**

In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:  
**AE,AL,AM,AP,AT,AZ,BA,BB,BG,BR,BY,CA,CH,CN,CR,CU,CZ,DE,DK,DM,EA,EE,EP,ES,FI,GB,GD,GE,GH,GM,HR,HU,ID,IL,IN,IS,JP,KE,KG,KZ,LC,LK,LR,LS,LT,LU,LV,MA,MD,MG,MK,MN,MW,MX,NO,NZ,OA,PL,PT,RO,RU,SD,SE,SG,SI,SK,SL,TJ,TM,TR,TT,TZ,UA,UG,UZ,VN,YU,ZA,ZW**  
The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).
3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on 14 December 2000 (14.12.00) under No. WO 00/75389

**REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)**

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, a demand for international preliminary examination must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

**REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))**

If the applicant wishes to proceed with the international application in the national phase, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

<p style="text-align: center;">The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland</p> <p>Facsimile No. (41-22) 740.14.35</p>	<p>Authorized officer</p> <p style="text-align: center;">J. Zahra</p> <p>Telephone No. (41-22) 338.83.38</p>
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## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/AU00/00630

**A. CLASSIFICATION OF SUBJECT MATTER**

Int. Cl. <sup>7</sup>: C22C38/06, 38/16, 38/08, 38/18, 38/34, 38/20, 38/40, 38/42, H01M 2/16, 8/12

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC: C22C38/06, 38/16, 38/08, 38/18, 38/34, 38/20, 38/40, 38/42, H01M 2/16, 8/12

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DWPI: Search terms - aluminum or aluminium or Al, silicon or Si, heat resist+, fuel cell, alloy, iron or steel

Chem Abs: Key words - Heat-resistant, fuel cell

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Derwent Abstract Accession No. 88-319147/45, class X16, JP, A, 83236267 [AGENCY OF IND SCI (KOBM)] 3 October 1988 (03. 10. 88) (see the entire abstract)	1-3, 6, 8-11
X	Derwent Abstract Accession No. 62529Y/35, class M27, SU, A, 544709, (SHUR, N. F.) 1 March 1977 (01. 03. 1977) (see the entire abstract)	1,2,6, 8-11
A	Derwent Abstract Accession No. 86-110024/17, class M13, JP, A, 1052356 (NIPPON STEEL CORP) 15 March 1986 (15.03.86) (see the entire abstract)	1 - 11

☒ Further documents are listed in the continuation of Box C ☒ See patent family annex

* Special categories of cited documents:	
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search  
11 July 2000

Date of mailing of the international search report  
13 JUL 2000

Name and mailing address of the ISA/AU  
AUSTRALIAN PATENT OFFICE  
PO BOX 200, WODEN ACT 2606, AUSTRALIA  
E-mail address: pct@ipaustalia.gov.au  
Facsimile No. (02) 6285 3929

Authorized officer

**B. PREMARATNE**

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/AU00/00630

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Derwent Abstract Accession No. 29632 E/15, class M27, JP, A, 57039159 [SHIN HOKOKU SEITETSU KK(YAWA)] 4 March 1982 (04.03.82) (see the entire abstract)	1 - 11
A	US 5565167 A (Fujimoto et al.) 15 October 1996 (05. 10. 1996) (see the entire document)	1 - 11

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

International application No.  
**PCT/AU00/00630**

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search  
Report

Patent Family Member

US 5565167

JP 7188870

WO 9513404

END OF ANNEX

11)

**PATENT COOPERATION TREATY**  
**PCT**  
**INTERNATIONAL PRELIMINARY EXAMINATION REPORT**  
(PCT Article 36 and Rule 70)

REC'D 20 JUL 2001  
WIPO PCT

Applicant's or agent's file reference 2298733	<b>FOR FURTHER ACTION</b>	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416).
International Application No. <b>PCT/AU00/00630</b>	International Filing Date (day/month/year) 2 June 2000	Priority Date (day/month/year) 4 June 1999
International Patent Classification (IPC) or national classification and IPC  Int. Cl. <sup>7</sup> C22C 38/06, 38/16, 38/08, 38/18, 38/34, 38/20, 38/40, 38/42, H01M 2/16, 8/12		
Applicant CERAMIC FUEL CELLS LIMITED et al		

1.	This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.																								
2.	This REPORT consists of a total of 3 sheets, including this cover sheet. <input type="checkbox"/> This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).  These annexes consist of a total of      sheet(s).																								
3. This report contains indications relating to the following items: <table style="width: 100%; border: none;"> <tr> <td style="width: 5%;">I</td> <td style="width: 5%;"><input checked="" type="checkbox"/></td> <td>Basis of the report</td> </tr> <tr> <td>II</td> <td><input type="checkbox"/></td> <td>Priority</td> </tr> <tr> <td>III</td> <td><input type="checkbox"/></td> <td>Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</td> </tr> <tr> <td>IV</td> <td><input type="checkbox"/></td> <td>Lack of unity of invention</td> </tr> <tr> <td>V</td> <td><input checked="" type="checkbox"/></td> <td>Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</td> </tr> <tr> <td>VI</td> <td><input type="checkbox"/></td> <td>Certain documents cited</td> </tr> <tr> <td>VII</td> <td><input type="checkbox"/></td> <td>Certain defects in the international application</td> </tr> <tr> <td>VIII</td> <td><input type="checkbox"/></td> <td>Certain observations on the international application</td> </tr> </table>		I	<input checked="" type="checkbox"/>	Basis of the report	II	<input type="checkbox"/>	Priority	III	<input type="checkbox"/>	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability	IV	<input type="checkbox"/>	Lack of unity of invention	V	<input checked="" type="checkbox"/>	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement	VI	<input type="checkbox"/>	Certain documents cited	VII	<input type="checkbox"/>	Certain defects in the international application	VIII	<input type="checkbox"/>	Certain observations on the international application
I	<input checked="" type="checkbox"/>	Basis of the report																							
II	<input type="checkbox"/>	Priority																							
III	<input type="checkbox"/>	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability																							
IV	<input type="checkbox"/>	Lack of unity of invention																							
V	<input checked="" type="checkbox"/>	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement																							
VI	<input type="checkbox"/>	Certain documents cited																							
VII	<input type="checkbox"/>	Certain defects in the international application																							
VIII	<input type="checkbox"/>	Certain observations on the international application																							

Date of submission of the demand 20 December 2000	Date of completion of the report 12 July 2001
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer  <b>B. PREMARATNE</b> Telephone No. (02) 6283 2407



**I. Basis of the report**

1. With regard to the **elements** of the international application:\*
- ☒ the international application as originally filed.
- ☐ the description,        pages , as originally filed,  
   pages , filed with the demand,  
   pages , received on    with the letter of
- ☐ the claims,                pages , as originally filed,  
   pages , as amended (together with any statement) under Article 19,  
   pages , filed with the demand,  
   pages , received on    with the letter of
- ☐ the drawings,            pages , as originally filed,  
   pages , filed with the demand,  
   pages , received on    with the letter of
- ☐ the sequence listing part of the description:  
   pages , as originally filed  
   pages , filed with the demand  
   pages , received on    with the letter of
2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.  
These elements were available or furnished to this Authority in the following language which is:
- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).
3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:
- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished
4. ☐ The amendments have resulted in the cancellation of:
- ☐ the description,        pages
- ☐ the claims,            Nos.
- ☐ the drawings,        sheets/fig.
5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).\*\*

\* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

\*\* Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/AU00/00630

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement****1. Statement**

Novelty (N)	Claims 4, 5, 7	YES
	Claims 1 - 3, 6, 8 - 11	NO
Inventive step (IS)	Claims 4, 5, 7	YES
	Claims 1 - 3, 6, 8 - 11	NO
Industrial applicability (IA)	Claims 1 - 11	YES
	Claims	NO

**2. Citations and explanations (Rule 70.7)****NOVELTY**

D1 = JP 83236267 (Abstract)

D2 = SU 544709 (Abstract)

Both D1 and D2 disclose heat resistant alloys containing aluminium and silicon. Compositions in claims 1-3 fall within the disclosures of D1 and D2. Since the alloys disclosed in D1 and D2 contain a relatively high content of aluminium a layer of aluminium oxide will form on the surface when the alloys are heated, thus making claim 6 not novel. Claims 8-11 refer to either processes or components known in the art and will not add anything new.

**INVENTIVE STEP**

As above

# PATENT COOPERATION TREATY

## PCT

### INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>2298733</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/AU00/00630</b>	International filing date <i>(day/month/year)</i> <b>2 June 2000</b>	(Earliest) Priority Date <i>(day/month/year)</i> <b>4 June 1999</b>
Applicant <b>CERAMIC FUEL CELLS LIMITED et al</b>		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 4 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

**1. Basis of the report**

a. With regard to the language, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ Certain claims were found unsearchable (See Box I).

3. ☐ Unity of invention is lacking (See Box II).

4. With regard to the title, ☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the abstract, ☒ the text is approved as submitted by the applicant

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is Figure No.

☐ as suggested by the applicant.

☐ None of the figures

☐ because the applicant failed to suggest a figure

☐ because this figure better characterizes the invention